

DETAILED ACTION

Summary

1. This is the initial office action based on application 10/577,915 filed on 05/01/2006 by Yoshinori Iwanaga.
2. Claims 1-14 are currently pending and have been fully considered.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. Claims 1-2, 4-5, and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over LIN (US 6,048,650) in view of NGUYEN (US 5,906,910).

6. LIN teaches a halftone phase shift mask comprising a second pattern on the backside of the substrate (abstract). The mask further comprises a back surface pattern on a transparent substrate and a front surface (column 2 lines 52-54). The

pattern on the back of the substrate is formed at the border of the transparent substrate and may be used for mask alignment (column 2 lines 56-58), and is therefore not a device pattern. The back of the substrate includes an inner region and a shaded border region (column 3 lines 46-50), the shaded border region is analogous to the light transmission reducing means. Additionally as seen in Fig. 5A the shaded border region is located at the edge of the mask, and is therefore operable to reduce the transmission of exposure light from entering the peripheral portion of the back surface of the substrate. An opening is formed in the shaded region for alignment (column 3 lines 56-57). Additionally in order to reduce the light reflection on the shielding layer, an antireflection layer may be coated on the light shielding layer to avoid an affecting the light resolution (column 3 lines 58-61).

7. However, LIN does not explicitly teach that the photomask is formed with a light shielding film pattern on the front surface of the transparent substrate. Instead LIN teaches the use of a half tone phase shifting layer (column 2 lines 52-54).

8. NGUYEN teaches a phase shift mask pattern comprising on a transparent substrate a multilayer pattern of a halftone film pattern, and an opaque pattern (column 13 lines 41-56, and see Fig. 18(e)). The advantage of the multi-level phase shifting reticle is that it reduces constructive, and unintended, interference of light patterns diffracting from a reticle aperture (column 3 lines 18-22) which create sharp features and reduce errors caused by diffraction (column 4 lines 36-41).

9. At the time of the invention one having ordinary skill in the art would have been motivated to use the multi-layer pattern, including the opaque mask pattern as taught by

NGUYEN in the phase shifting mask of LIN, because the multi-layer pattern of NGUYEN has the advantage of create a pattern with sharp features and reduced errors caused by diffraction (NGUYEN column 4 lines 37-41).

10. With respect to claim 10. LIN further teaches that integrated circuits are created using the photolithographic technology (column 1 lines 18-22).

11. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over LIN (US 6,048,650) in view of NGUYEN (US 5,906,910), and further in view of OHTAGURO (US 2004/0248017 A1).

12. Claim 3 is dependent upon claim 1 which is rejected above in view of LIN and NGUYEN. However, neither LIN nor NGUYEN explicitly teaches that the light-transmission reducing means is formed by a surface roughening treatment of the surface of the substrate.

13. OHTAGURO teaches a method of using a diamond tool to roughen a surface of a substrate (surface C, which is the top surface as shown in Fig. 1C) in order to make the substrate semi-transparent (paragraph 0049).

14. At the time of the invention one having ordinary skill in the art would have been motivated to use the surface roughening technique of OHTAGURO for the photomask of LIN as modified by NGUYEN, since the surface roughening technique has the added benefit of eliminating generation of particles (OHTAGURO paragraph 0012).

Claim Rejections - 35 USC § 102 and 103

15. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

16. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

17. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

18. Claims 6-9 and 11-14 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over TANAKA (US 2002/0034694).

19. TANAKA teaches a photomask comprising a transparent substrate 36, with a desired pattern, 31 in the chip field 32, or exposure region, and alignment pattern 35, which is a non device pattern (paragraph 0007). In the non device region, which is in

the peripheral portion, there is the non device pattern 35, which comprises a chromium shade film 35 (paragraph 0007, see Fig. 3a). The main pattern is formed in the half tone film area (paragraph 0008).

20. TANAKA does not explicitly teach that the pattern portion and the non pattern portion differ in reflectance with respect to exposure light entering from a front surface of the photomask, but no substantial difference in reflectance between the pattern portion and the non pattern portion is generated with respect to exposure light entering from a back surface of the photomask.

21. However, since light entering from the back portion, or through the transparent substrate would reflect off of the same film area, of the halftone film, the reflectance through the back portion of the photomask would be the same in both the non pattern area, such as where the alignment mark 35 is located, and the chip field area 32 (see Fig. 3b). Additionally light entering from the front surface would reflect off of the shade film in the non pattern area, and off the halftone field in the chip field 32, which both have different material properties as well as different thicknesses which would amount to different reflectance from light entering the front of the mask (see Fig. 3b). Thus it is the combination of the location of the light shielding film 33 that causes the change in reflectance.

22. TANAKA further teaches that the mask is illuminated in a specific area to be exposed, which is determined using the alignment marks to precisely align the mask to project only the desired image onto the semiconductor wafer (paragraph 0057). Therefore, the different areas, of the chrome shading mask, and where there isn't, that

effects the reflectance in the non pattern area and the pattern area, allows for the non device pattern 35 not to be resolved onto the wafer, since it assists in the precise alignment of the mask, so that only the desired pattern is transferred (paragraph 0057).

23. With respect to claim 9. TANAKA teaches a further embodiment comprising a shade band 6, which incorporates a pattern in both the outer region without the metal layer, as well as into the chip field (paragraph 0079, Fig. 8a). The mask comprises the pattern to be transferred, 3, in the main chip region 2, (paragraph 0041), as well as an alignment mark pattern (paragraph 0079) in a region that is not resolved by the exposure apparatus (paragraph 0057). Additionally the alignment pattern 108, comprises a finer pattern made up of the metal layer 102, and the halftone film 1, where the fine pattern is the region of the opening to the transparent substrate 8, and the full alignment pattern including the fine pattern is the whole alignment mark which comprises the opening in the halftone film, as well as the opening to the transparent substrate (paragraphs 0079-0080).

24. With respect to claims 11-14. TANAKA further teaches that the mask is used for the manufacturing of integrated circuit devices (paragraph 0004) via exposure of the mask pattern (paragraph 0057).

Conclusion

25. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jonathan Jelsma whose telephone number is (571)270-

5127. The examiner can normally be reached on Monday to Thursday 7:00 a.m. - 5:00 p.m.

26. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on (571)272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

27. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Mark F. Huff/
Supervisory Patent Examiner, Art Unit 1795

JGJ